



UNIVERSITI PUTRA MALAYSIA

**DESIGN, ANALYSIS AND FABRICATION OF PLASTIC INJECTION
MOULD FOR TENSILE TEST SPECIMEN**

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By

MOHD KHAIROL ANUAR BIN MOHD ARIFFIN

**Thesis Submitted in Fulfilment of the Requirement for the Degree of
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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in
fulfilment of the requirement for the degree of Master of Science

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September 2001

Chairman: Associate Professor Shamsuddin Sulaiman, Ph.D.

Faculty: Engineering

The aim of this project is to design, analyse and produce the plastic injection mould for tensile test specimen. It is also concerned with presenting the technique, method, and theory for producing the plastic injection mould. This project is divided into three sections, namely design, analysis and fabrication. Each of the previous mentioned section is illustrated in proper order to ensure that the readers have a good understanding on how the process is done.

The design of the mould is governed first by its intended function and is restricted by the specification limitation of the injection moulding process. Two other factors have to be considered such as material specification and mould condition. The total design method was used in this project to design, analyse and fabricate the mould. This concept allows us to produce the best conceptual design. The techniques in Total Design Method used were Product Design Specification, Quality Function Deployment and Matrix Evaluation System.

In the design section, Unigraphics CAD/CAM system is used to produce the detail design and the numerical control codes that are needed to assist machining mould components. Careful consideration has to be taken during selection of various machines that can be used to manufacture the mould. In this project a Computer Numerical Control (CNC), milling, drilling, grinding and Electrode Discharge Machining (EDM) machines were used to machine the mould components.

The rework cost is a major problem to the mould making industries, therefore by integrating the Moldflow analysis software (part advisor version 4) into the mould fabrication process this problem can be avoided. This software simulates how the molten plastic enters the mould during the injection process and also the possible defects that might occur. This step will eliminate the rework cost and time as all the possible errors are eliminated before it actually occur in the actual production process.

The quality of the mould and injected product depend on the processing conditions such as melt temperature, mould temperature and injection pressure as well as the machines used to fabricate the mould.

As a conclusion the aim of the project to create a mould for tensile test specimen has been achieved.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**REKABENTUK, ANALISA DAN MEMBUAT ACUAN SUNTIKAN PLASTIK
UNTUK PRODUK UJIAN KETEGANGAN**

Oleh

MOHD KHAIROL ANUAR MOHD ARIFFIN

September 2001

Pengerusi : Profesor Madya Shamsuddin Sulaiman, Ph.D.

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Matlamat utama projek ini adalah membuat acuan suntikan plastik untuk spesimen ujian ketegangan dengan menggunakan kaedah rekabentuk, pemesanan dan analisa terhadap pengaliran cecair plastik. Projek ini mempersembahkan pelbagai teknik yang digunakan untuk menjana idea-idea baru dengan menggunakan teknik-teknik, teori-teori dan juga metodologi dalam merekabentuk acuan suntikan plastik. Projek ini dibahagikan kepada tiga bahagian iaitu: bahagian rekabentuk, bahagian pemesanan dan bahagian analisa seperti yang dinyatakan di atas. Setiap bahagian diperalusi dengan teliti supaya setiap pembaca memahami isi kandungan yang hendak disampaikan.

Proses rekabentuk dibuat adalah berdasarkan kepada fungsi produk tersebut dengan mengambil kira kesesuaian dan had penggunaan pada mesin suntikan yang tertentu dan juga menepati kos yang dianggarkan. Faktor-faktor lain yang perlu diambil kira ialah faktor bahan-bahan yang digunakan dan juga keadaan permukaan pada acuan tersebut. Keseluruhan cara

rekabentuk telah diguna pakai sepenuhnya dalam projek ini yang akhirnya akan menghasilkan konsep rekabentuk yang terbaik. Konsep-konsep yang telah diguna pakai adalah kaedah Tetentuan Rekabentuk Produk, Fungsi Mutu serta Penilaian Matrik.

Bantuan komputer (CAD/CAM) 'Unigraphics' digunakan untuk merakabentuk produk, acuan dan seterusnya menjanakan beberapa kod kawalan berangka untuk proses pemesinan. Kerja-kerja memilih cara pemesinan untuk acuan dijalankan dengan teliti supaya acuan yang dihasilkan bermutu tinggi. Dalam projek ini mesin-mesin yang digunakan adalah mesin Kawalan Berangka Berkomputer (CNC)', mesin pengisar, mesin gerudi dan mesin 'Electrode Discharge Machining (EDM) untuk meghasilkan acuan.

Analisa terhadap pengaliran cecair plastik dijalankan dengan menggunakan perisian (MoldFlow – Part Advisor version 4). Kaedah ini digunakan adalah untuk mendapatkan idea bagaimana cecair plastik ini bertindak kepada acuan yang direka. Kaedah ini menjimatkan kos dimana kerja-kerja pegubahsuaian tidak lagi diperlukan kerana segala masalah yang mungkin timbul telah diselesaikan terlebih dahulu sebelum kerja-kerja pemesinan dijalankan.

Mutu acuan dan produk selepas suntikan yang dihasilkan adalah berdasarkan kepada pemilihan bahan-bahan dan cara-cara pemesinan yang digunakan dan juga cara pemprosesan seperti suhu lebur, suhu acuan dan tekanan suntikan untuk menghasilkan produk suntikan tersebut.

Sebagai kesimpulan matlamat utama projek ini untuk membuat acuan suntikan plastik bagi spesimen ujian ketegangan telah berjaya.

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M.K.A Mohd Ariffin

I certify that an Examination Committee met on 17th September 2001 to conduct the final examination of Mohd Khairul Anuar bin Mohd Ariffin on his Master of Science thesis entitled "Design, Analysis and Fabrication of Plastic Injection Mould for Tensile Test Specimen" in accordance with Universiti Pertanian Malaysia (Higher Degree) regulation Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION FORM

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that if it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



Mohd Khairul Anuar Mohd Ariffin

Date: 12 November 2001

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LIST OF ABBREVIATIONS

PE	POLYETHYLENE
PP	POLYPROPYLENE
NC	NUMERICAL CONTROL
PDS	PRODUCT DESIGN SPECIFICATION
QFD	QUALITY FUNCTION DEPLOYMENT
UG	UNIXGRAPHIC
3-D	THREE DIMENSIONAL
2-D	TWO DIMENSIONAL
CL	CUTTER LOCATION
CNC	COMPUTER NUMERICAL CONTROL
EDM	ELECTRO DISCHARGE MACHINING
CLSF	CUTTER LOCATION SPECIFICATION FILE
PTP	POINT TO POINT
STL	CERTIFICATE TRUE LIST FILE EXTENSION
MDF	MACHINING DEFINED FILE